APPLICABILITY OF WEBCAMS TO INVENTORY CONTROL OF TECHNICAL WHOLESALE ITEMS

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Abstract: This study aimed to determine whether webcams could be applied to the operative and tactical inventory control of technical wholesale items for which customers do not keep track of the inventory balance. The study was conducted as a ten-case study in Finnish industry with machinery industry companies as the customers and technical wholesalers as the suppliers. Even though none of the cases used webcams in their inventory control, the research results indicate that that webcams could be suitable for the purpose particularly in operative order-delivery process. However, webcam systems are considerably more challenging to apply to tactical inventory control.

1 INTRODUCTION

The research was conducted as a ten-case study in Finnish industry with machinery industry companies as the customers and technical wholesalers as the suppliers. The studied cases generally apply the VMI (Vendor-Managed Inventory) model, which in this research refers to inventory replenishment carried out by the wholesaler, who delivers items to shelf spaces in the customer's production facilities or warehouses in accordance with the management model agreed on. The management model is typically based on a number of control parameters, which include the lot size, order point and delivery frequency (Salmela et al. 2007).

Some of the studied cases utilized the CMI (Co-Managed Inventory) model. In the CMI the customer maintains a forecast and distributes it to the supplier, which means that some degree of management and responsibility is on the customer side. According to Seifert (2003), VMI is mostly based on warehouse levels and sales data, but not on forecasts – which makes CMI different from VMI.

Technical wholesale items (e.g. nuts and bolts) are typically standardized low-cost products with a constant demand and a rather short supply chain. Nonetheless, some of the items play a critical role because their absence may bring the entire production line to a halt. Common ways of avoiding such shortages include large storage buffers and frequent inventory checks (Salmela et al. 2007).

Technical wholesale items usually include mechanical, electrical and hydraulics items used in production and maintenance. Customers usually keep track of the inventory balance of electrical equipment, which means they have records of them in their inventory systems. This enables the use of automatic and real-time control and order methods for these items. In contrast, customers' inventory systems rarely include records of the inventory level of mechanical and hydraulics items (Salmela et al. 2007). These items are the particular focus of this study

Transparency of information is needed in the VMI and CMI models. In transparent supply chain, the decision maker has all the information needed to make decisions (Otto, 2003; Gaonkar and Viswanadham, 2003). In this research, the applicability of webcams is studied to improve decision making and transparency of information in the studied supply chains.

The VMI includes tactical and operative level tasks, information and decisions. At the tactical level, the main task is to adjust the control parameter values to correspond to item consumption. The consumption history data and demand forecasts are utilised to perform this task. In practice, the parameter value adjustment is done at the commissioning stage of the item (e.g. during the first

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six months), after which parameter adjustment is sporadic or non-existent. Usually, parameters are adjusted after the commissioning period only if shortages occur repeatedly or if the customer anticipates significant changes in demand. The low frequency of adjustments can be explained by the large amount of manual labor it requires, which results in costs higher than the expected profits (Salmela et al. 2007).

In operative level order-delivery process, wholesalers assess the customer's replenishment needs in connection with each replenishment visit. The replenishment need is normally based on a visual assessment of the inventory level. Rapidity is of the essence because the customer site may contain hundreds of shelf spaces. Due to the time constraints and visual checks, the assessment is not very precise. However, accuracy is not even necessary for the items in question due to wide safety margins. When inventory levels are below the order point, the wholesaler's representative normally records the need for replenishment and later enters the information into the wholesaler's system. Different methods were used for records and information transfer in different cases. For instance bar codes and laptop computers were used for recording replenishment needs, and remote access in transmitting the information in a batch run to the wholesaler's order system (Salmela et al. 2007).

Orders were typically entered into the wholesaler's order system at the end of replenishment day, or on the following day, at the latest. Normally, the studied cases exhibited no need for more real-time information transmission because the picking and delivery processes applied would have had no use for information sent any sooner (Salmela et al. 2007).

2 FINDINGS

A webcam system could be applied to the operative order-delivery process of technical wholesale items with no customer records on inventory balance. Webcams would be best suited to remote monitoring of large items, allowing the inventory levels to be assessed based on the picture. However, technical wholesale items are mainly small in size, which means some kind of visual signal would be necessary to indicate that the inventory level is below the order point and that a replenishment decision needs to be made.

Our research involved laboratory-environment modelling of an industrial shelf with tilted boxes. Labels indicating the order point were fastened on the bottom of the boxes. After this, pictures were taken at different distances and in different lighting conditions. The results of the laboratory tests were positive, i.e. technically, the webcam system is suitable for remote monitoring of small technical wholesale items. The items should roll or slide down easily in the tilted boxes as the inventory level decreases. Alternatively, the boxes should be at such a great angle that sliding is inevitable as the inventory level drops.

Merely seeing the order point label in the webcam picture is not enough to make a replenishment decision because the items cannot be identified from the pictures. The identification would require documentation on the shelf location of the items. This information could be on a separate document or pasted as layered information on the picture taken by the camera. Furthermore, manual work is needed to adjust order point parameters, because the labels fastened on the bottom of the boxes must be manually moved.

In addition to replenishment decisions based on remote monitoring, the webcam system could be applied to the management of extensive and rapid changes in consumption by comparing two consecutive pictures to each other. Especially overtime work may increase the customer's consumption significantly, and pictures sent to the supplier daily would provide information on these kinds of changes.

The simplest technological solution would be for the webcam to email pictures directly to the supplier. This could be applied to cases where the number of pictures is low and/or pictures are sent at low frequencies. As the number of pictures increases, some kind of application (e.g. for recording, searching and filing pictures) is needed to manage the order-delivery process.

The webcam system helps to increase the efficiency of operative order-delivery process through remote monitoring and replenishment decisions. The system cannot, however, be used for automatic control parameter adjustment at a tactical level because it does not provide arithmetic information on the inventory balance and on the consumption of the items. In the absence of inventory balance information, the consumption history cannot be analysed and control parameters cannot be adjusted automatically.

3 CONCLUSIONS AND FUTURE RESEARCH

A webcam system can help in improving the efficiency of an operative order-delivery process, whereas in tactical inventory management, automatic control parameter adjustment would result in excessive costs compared to the profits, or be altogether unfeasible. Tactical gains could be achieved with a system of scales or by including the items in inventory accounting in the inventory management system (Happonen & Salmela, 2007).

A webcam-based solution can be applied to inventory control only in certain type of supply chain environment. The fundamental requirement for applying a webcam-based solution is that the wholesaler has no information on the customer's inventory balance. Below are some additional arguments for adopting a webcam system:

- The number of items is low, which would allow for a webcam system which requires manual labor (e.g. browsing pictures is a slow task).
- When consumption is low, the replenishments of items and the inventory level checks are infrequent.
- The consumption of items fluctuates (e.g. maintenance items).
- The customer is logistically far away, which makes frequent replenishment and inventory inspection visits unfeasible due to the related labor and travel expenses.
- The customer does not want to the wholesaler's representative to make inventory inspection visits to the plant/warehouse for instance for information security reasons.
- The facilities are difficult to inspect in person (e.g. high-rise warehouses).
- The lighting conditions in the plant/warehouse are quite good.
- The replenishment limit can be identified from a photograph.
- The physical characteristics of the item allow it.

The advantage of the webcam system is its simplicity and low commissioning costs compared, for instance, to a scale system. On the other hand, its disadvantages are that its use is limited to the operative level and it still requires manual labor.

Further research is necessary on the incorporation of pattern recognition and shelf space coordinate features into the system. For example, a pattern recognition function could automatically identify the label at the bottom of the box, indicating the need for replenishment. Shelf space coordinates would allow connecting items to specific shelf spaces. Connecting the replenishment need and item identification information would enable placing fully automated replenishment orders directly into the wholesaler's system.

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